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## Transition to clinical training: influence of pre-clinical knowledge and skills, and consequences for clinical performance

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**CONTEXT** Many students experience a tough transition from pre-clinical to clinical training and previous studies suggest that this may constrict students' progress. However, clear empirical evidence of this is lacking. The aim of this study was to determine: whether the perceived difficulty of transition influences student performance during the first 2 weeks of clerkships; whether it influences students' overall performance in their first clerkship, and the degree to which the difficulty of transition is influenced by students' pre-clinical knowledge and skills levels.

**METHODS** Clerks ( $n = 83$ ) from a university hospital and eight affiliated hospitals completed a questionnaire measuring the perceived difficulty of the transition period. Data collected included student scores on pre-clinical knowledge and skills, their performance during the second week of the first clerkship, and their overall performance in the first clerkship. Univariate and multivariate multiple regression analyses were used to analyse the data.

**RESULTS** The perceived difficulty of transition was neither predictive of student performance during the transition period (adjusted  $R^2 = 11.8\%$ ,  $P = \text{NS}$ ), nor of their overall clerkship performance (adjusted  $R^2 = 8.6\%$ ,  $P = \text{NS}$ ). Students' pre-clinical knowledge and skills played a minor role in the perceived difficulty of the transition period.

**CONCLUSIONS** The negative effect of the transition period on student progress suggested in the literature was not found in this study. A possible explanation for the limited influence of students' knowledge and skills on performance during the transition period is that the workload in this period causes a cognitive overload, interfering with students' abilities to apply their pre-clinical knowledge and skills.

**KEYWORDS** multicenter study [publication type]; clinical competence/\*standards; clinical medicine/\*education\*clinical clerkship; stress, psychological; humans; Netherlands; students, medical/\*psychology; \*attitude of health personnel; educational status.

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### INTRODUCTION

Clinical training during clerkships is an essential stage in medical education. During this stage students have the opportunity to apply and, more importantly, to develop the necessary competencies in an authentic clinical environment. Learning in this real-life context is a cognitive and social process, also called situated learning.<sup>1</sup> The transition to the clinical training stage can be both exciting and worrying for students.<sup>2</sup> Many students experience what is referred to as the 'shock of practice' when they enter the clinical training stage, as their role shifts from one of being taught to one of providing patient care.<sup>2–9</sup> They report difficulties with their new roles and problems with dealing with death and suffering, the pressure of professional socialisation and workload, deficiencies in knowledge and feelings of inadequacy while carrying out simple practical procedures.<sup>3,4,6–9</sup> The literature suggests that transition problems stifle student progress and should therefore be reduced.<sup>7,9</sup> However, empirical data are lacking.

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## Overview

### What is already known on this subject

The literature suggests that a difficult transition from pre-clinical to clinical training impedes students' progress. Increasing students' knowledge and skills before they enter the clinical phase may ease this transition.

### What this study adds

This study provides empirical data on the influence of the perceived difficulty of the transition period. This perceived difficulty does not influence students' clinical performance and is not dependent on students' pre-clinical knowledge and skills levels.

### Suggestions for further research

Further research is needed to analyse the increased cognitive load during the pre-clinical–clinical transition period.

The question is, therefore, whether a stressful transition period hampers learning.

Stress can be conducive as well as inhibitive to learning. A certain amount of stress is considered necessary for students to perform well as it can be a powerful motivator.<sup>4,10</sup> Furthermore, learning to deal with stressful situations is regarded as an important learning experience preparatory to subsequent professional practice.<sup>4</sup> However, if the level of stress becomes too high, it may become counterproductive.

To explore the consequences of transition problems, we investigated whether student-perceived difficulties related to the transition period influenced:

- 1 students' performance during this period, and
- 2 students' overall performance during their first clerkship.

An important and interesting issue concerns which factors make the transition more difficult. Previous research has revealed that 'the majority of the clerks perceived gaps in their knowledge and half of them did not have the knowledge readily available'.<sup>9</sup> In addition, '43% had difficulty recognising symptoms and only a quarter felt confident about findings from

history and physical examination'.<sup>9</sup> Therefore, it seems reasonable to expect that increasing students' knowledge and skills levels before the start of their clerkships will improve students' preparedness for clinical practice.<sup>2</sup> However, there is little empirical evidence as to the degree to which transition difficulties are influenced by deficiencies in knowledge and skills. Consequently, we also investigated whether:

- 3 students' pre-clinical knowledge and skills levels influenced the perceived difficulty of the transition period.

## METHODS

### Context

This study was carried out at the University of Groningen in the Netherlands. The undergraduate curriculum of the Faculty of Medical Sciences includes 4 years of problem-based learning (PBL) and patient-centred learning, followed by 2 years of clinical training during clinical clerkships. During the first 10 trimesters, each week starts with the introduction of a real patient. Students question the teacher and patient about the patient's problem. In tutorial groups, students study the case further, alongside three related patient problems on paper. Students also complete twice-weekly communication training during the first six trimesters and clinical skills training during the subsequent four trimesters. At the end of the 10th trimester, students' skills are assessed by an objective structured clinical examination (OSCE). In addition, the third trimester includes a 2-week internship in a nursing department and the 10th trimester includes a 2-week training period in general practice.

After the pre-clinical phase, further training takes place during six clerkship rotations either at the university hospital or in a non-academic affiliated hospital. The first clerkship rotation lasts 14 weeks and consists of 8 weeks in internal medicine, 2 weeks in cardiology, 2 weeks in dermatology and 2 weeks in pulmonary diseases.

### Participants and procedure

The study design was discussed with the heads of education at each hospital before their approval was sought. The research data were collected at the university hospital and the eight affiliated hospitals. All students ( $n = 101$ ) starting their first clerkship

rotation between December 2005 and April 2006 were asked to complete a questionnaire during their second clerkship week. At the top of the questionnaire students were informed of the nature of the research. Participation was voluntary and all clinical clerks participating in this study provided informed consent. The questionnaires were returned in sealed envelopes and confidentiality was guaranteed. The response rate was maximised by sending one reminder to non-respondents. To eliminate the effects of previous experience, students with foreign medical degrees or degrees in health sciences were excluded from the research group. The students and the head of education of each hospital received descriptive data concerning the scores at their own hospital site.

### Instruments

#### *Perceived difficulty of transition period*

To assess whether students experienced the course of their transition period as problematic, we adapted a questionnaire designed by Prince *et al.*<sup>9</sup> This questionnaire was developed to explore students' recent experiences as 'new' clerks. The questionnaire consists of 77 statements scored on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). Not all statements were suitable for measuring the difficulty of the transition period as experienced by individual students. The following procedure was applied to identify and exclude non-suitable statements. Nine medical education experts and researchers individually assessed the statements' relevance for measuring transition difficulty and discussed their findings jointly. Examples of statements removed

from the original questionnaire are: 'A general introduction should be provided to all new clinical clerks' and 'I study primarily for tests and examinations'. Such items do not indicate the extent to which a student experiences the transition period as difficult.

This resulted in a 53-statement questionnaire. An exploratory factor analysis with varimax rotation on the 53 statements revealed five scales. These scales were interpreted by the first author and two co-authors as:

- 1 have enough knowledge;
- 2 have enough [patient contact] skills;
- 3 useful pre-clinical curriculum;
- 4 appropriate workload, and
- 5 smooth cognitive and emotional adaptation.

The scale names are presented in Table 1 with an example item, the number of items and the reliability of the scale. The reliability of the whole questionnaire was 0.89.

#### *Pre-clinical knowledge and skills*

The mean score of the last two inter-university progress tests (PTs) that students sat before they started their clerkships (September, December 2005) served as an indicator of students' pre-clinical knowledge level. Four times a year, all medical students from four universities sit the same PT. Each PT consists of 200 true/false/don't know items assessing knowledge at graduate level.<sup>11</sup> The question mark option (zero points) is provided to discourage students from blind guessing and should be

Table 1 Perceived difficulty of transition, showing example items, number of items, reliabilities, mean scores and standard deviations for questionnaire scales (1 = strongly disagree, 5 = strongly agree)

Scale	Exemplary item	No. items	$\alpha$	Mean (SD)
1 Have enough knowledge	I was sufficiently prepared for the clerkships as regards theoretical knowledge	13	0.80	3.29 (0.50)
2 Have enough [patient contact] skills	I felt well prepared for clinical skill performance	13	0.83	3.73 (0.48)
3 Useful pre-clinical curriculum	The first years in medical school were relevant for clinical practice	11	0.74	3.35 (0.48)
4 Appropriate workload	The workload of clinical clerks is heavy	5	0.70	2.80 (0.69)
5 Smooth cognitive and emotional adaptation	The first few weeks as a clinical clerk were difficult for me	11	0.76	3.62 (0.53)

SD = standard deviation

selected if they do not (yet) know the answer. Test results are based on the subtraction of the number of incorrect answers from the number of correct answers.

Students' pre-clinical skills level were determined using their OSCE scores achieved prior to the start of their clerkships. All students received a global grade per station. Final average scores were measured on a 10-point scale (1 = very low, 10 = very high), with a pass mark of 5.50.

#### *Clinical performance*

Clinical performance during the clerkships is regularly assessed by clinical teachers using a structured document. Students' overall clinical performance, hereafter called 'clerkship performance', is the mathematical mean of seven clinical evaluations performed during the first clerkship. Clerkship performance is based on the students' performance on six competencies: history taking; physical examination; problem analysis/clinical judgement; communication skills; organisation and efficiency, and professionalism. The assessment score is expressed as a global score on a 10-point scale (1 = very low, 10 = very high; pass mark = 5.50). Clinical performance during the transition period, hereafter called 'transition performance', was assessed in the second clerkship week.

#### **Statistical analysis**

We performed two separate univariate multiple regression analyses to investigate the influence of the perceived difficulty of transition on student performance. The dependent variable in the first univariate analysis was 'transition performance'; in the second analysis it was 'clerkship performance'. In both analyses students' pre-clinical knowledge and skills scores were entered at the first step (model A) and the perceived difficulty of transition at the second step (model B). The influence of perceived difficulty of transition was measured by entering the scale scores into the analyses, with the scale scores being the mean score of the scale items (after inversion of negative items).

To investigate the influence of pre-clinical knowledge and skills levels on the perceived difficulty of transition, we performed a multivariate multiple regression analysis. In this analysis, the five scale scores representing the perceived difficulty of transition formed the dependent variables. The independent variables were pre-clinical knowledge and pre-clinical skills.

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## RESULTS

### **Descriptives**

The response rate in this study was 82% ( $n = 83$ ). Of the respondents, 70% were women and 30% men, which is representative of the gender distribution of medical students at the university under study. No gender differences were found in the five scale scores measuring perceptions of difficulty of transition, nor in pre-clinical knowledge, pre-clinical skills, transition and clerkship performance scores. Students were relatively content with their knowledge level (scale 1), the [patient contact] skills they possessed (scale 2), the usefulness of the pre-clinical curriculum (scale 3), and their cognitive and emotional adaptation to clinical training (scale 5), (means = 3.29–3.73, Table 1). Students experienced most difficulties with the workload (scale 4), (mean = 2.80).

### **Influences on clinical performance**

Students' pre-clinical knowledge and skills levels accounted for 8.6% of the variance in 'transition performance' and 18.1% in 'clerkship performance' (Tables 2 and 3, model A). Perceived difficulty of transition did not enhance the regression models: in other words, students who perceived the transition as more difficult performed as well as students who found it less difficult (Tables 2 and 3, model B). Pre-clinical knowledge and skills levels influenced overall clerkship performance significantly ( $\beta = 0.30$ ,  $P < 0.05$  and  $\beta = 0.26$ ,  $P < 0.05$ , respectively). Transition performance was not influenced by pre-clinical knowledge and skills.

### **Influences on perceived difficulty of transition**

Students' pre-clinical knowledge and skills levels barely influenced the perceived difficulty of transition (Table 4). Pre-clinical knowledge level only significantly influenced student satisfaction with the pre-clinical curriculum ( $P < 0.001$ ). Pre-clinical skills level did not significantly influence the perceived difficulty of transition.

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## DISCUSSION AND CONCLUSIONS

Students' pre-clinical knowledge level, pre-clinical skills level and perceived difficulty of the transition to clinical training did not influence students' performance during the transition period. Students' overall performance in their first clerkship was only

Table 2 Univariate stepwise multiple regression analysis. Dependent variable: transition performance

	Model A			Model B		
	B	SE	$\beta$	B	SE	$\beta$
Step 1						
Constant	5.95	0.87		5.36	1.07	
Pre-clinical knowledge	0.02	0.01	0.19	0.02	0.01	0.28
Pre-clinical skills	0.17	0.11	0.21	0.19	0.11	0.24
Step 2						
Have enough knowledge				– 0.35	0.20	– 0.30
Have enough [patient contact] skills				0.06	0.27	0.05
Useful pre-clinical curriculum				– 0.07	0.25	– 0.06
Appropriate workload				0.11	0.16	0.10
Smooth cognitive and emotional adaptation				0.31	0.21	0.27
$F (R^2)$	2.270 (0.086)			1.573 (0.204)		

SE = standard error

Table 3 Univariate stepwise multiple regression analysis. Dependent variable: clerkship performance

	Model A			Model B		
	B	SE	$\beta$	B	SE	$\beta$
Step 1						
Constant	6.05	0.59		5.62	0.79	
Pre-clinical knowledge	0.02	0.01	0.31*	0.02	0.01	0.30*
Pre-clinical skills	0.15	0.08	0.24	0.17	0.08	0.26*
Step 2						
Have enough knowledge				– 0.11	0.14	– 0.11
Have enough [patient contact] skills				– 0.27	0.20	– 0.23
Useful pre-clinical curriculum				0.15	0.18	0.14
Appropriate workload				0.12	0.11	0.14
Smooth cognitive and emotional adaptation				0.24	0.16	0.25
$F (R^2)$	6.068 <sup>†</sup> (0.181)			2.606* (0.267)		

\*  $P < 0.05$ ; <sup>†</sup>  $P < 0.01$ 

SE = standard error

influenced by their pre-clinical knowledge and skills levels and not by their perceived difficulty of transition. We conclude that neither the suggested negative effect of a difficult transition period on students' overall performance<sup>7,9</sup> nor the previously indicated

positive effect of stress as a motivator<sup>4,10</sup> were supported by our data.

A possible explanation for not finding an influence of the perceived difficulty of transition on transition

Table 4 Multivariate multiple regression analysis of the influence of pre-clinical knowledge and pre-clinical skills on perceived difficulty of transition

Predictor variables	Scale 1		Scale 2		Scale 3		Scale 4		Scale 5	
	B	SE	B	SE	B	SE	B	SE	B	SE
Intercept	2.42 <sup>‡</sup>	0.57	3.10 <sup>‡</sup>	0.54	2.42 <sup>‡</sup>	0.49	2.09 <sup>†</sup>	0.68	3.80 <sup>‡</sup>	0.61
Pre-clinical knowledge	0.01	0.01	0.01	0.01	0.03 <sup>‡</sup>	0.01	0.00	0.01	0.00	0.01
Pre-clinical skills	0.08	0.08	0.06	0.07	0.02	0.07	0.08	0.09	– 0.02	0.08
F (R <sup>2</sup> )	1.466 (0.044)		0.902 (0.028)		7.317 <sup>‡</sup> (0.189)		0.517 (0.016)		0.091 (0.003)	

Scale: 1 = have enough knowledge; 2 = have enough [patient contact] skills; 3 = useful pre-clinical curriculum; 4 = appropriate workload; 5 = smooth cognitive and emotional adaptation

<sup>†</sup>  $P < 0.01$ ; <sup>‡</sup>  $P < 0.001$

SE = standard error

performance is that clinical staff take into account the demanding nature of situated learning when grading students.<sup>1</sup> As a result, the effects of transition problems on student performance would not be reflected in their grades.

The results of this study show that the influence of students' knowledge and skills levels on the perceived difficulty of transition is almost negligible. Pre-clinical knowledge exerted only a small influence on the perceived difficulty of transition and pre-clinical skills level exerted no influence at all. In other words, there is barely any relationship between test results at the pre-clinical phase and the degree to which students experience the transition period as difficult. Therefore, increasing students' knowledge and skills levels before the start of clerkships does not appear to be effective in facilitating the transition. However, in the long run, levels of pre-clinical knowledge and skills do influence clinical performance positively if we consider their influence on overall performance of the first clerkship. It seems that after the initial shock of practice students were able to use their pre-clinical knowledge and skills in real-life learning. The positive influence of pre-clinical knowledge on students' overall performance during their first clerkship is in line with findings of previous research.<sup>12</sup>

In general, during the transition period, students are satisfied with their knowledge levels, the usefulness of the pre-clinical curriculum and their cognitive and emotional adaptation to clinical training. The fact that students are most secure with their [patient contact] skills can be explained by the skills training completed during pre-clinical years. This is in line

with previous findings in a PBL curriculum.<sup>8</sup> The results also show that although students' pre-clinical knowledge and skills levels influenced their overall clerkship performance, they did not influence performance during the transition period. It seems that during the transition period students did not make use of their pre-clinical knowledge and skills. Moreover, students experience most difficulties during the transition period with the extent of their workload. This is in line with previous findings.<sup>9</sup>

A possible explanation for the finding that pre-clinical knowledge and skills did not influence transition performance is that the extent of the workload leads to a cognitive overload.<sup>13,14</sup> A cognitive overload may occur when too much information has to be processed. This can occur with any type of information processing (i.e. cognitive or emotional). Possibly, students have difficulties coping with the increased input of novel information – both cognitive and emotional – during the transition period, which prevents them from using their previously stored information. Thus, students have too few cognitive resources to optimally retrieve information from longterm memory, which may seriously hamper learning.<sup>14</sup> To facilitate the use of previously stored information and improve the learning processes, the cognitive load during the transition period should be reduced. Therefore, we would like to support van Merriënboer and Sweller's conclusion that there is a need to develop a new instructional model to optimise the cognitive load for real-life learning.<sup>14</sup>

A possible way to facilitate the transition from pre-clinical training at university to clinical training

in a hospital and to optimise the cognitive load is to apply an instructional model in which pre-clinical and clinical training alternate. By having students travel back and forth between university and hospital, cognitive load may be lessened because new real-life learning tasks are learned in a safe environment in which the level of support is adjusted to the needs of the learner. In this model, personal learning needs are identified in a clinical context and, when students return to the university, specific skills that satisfy these needs are practised in a safe environment. This model can be seen as an expansion of Kneebone *et al.*'s model for an interactive relationship between the simulated and clinical environments.<sup>15</sup> Additionally, this model meets suggestions made by students for improving the transition to clinical training.<sup>9</sup> This innovative model has been implemented in a recently developed curriculum at the University of Groningen in co-operation with the University Medical Center Groningen.

The results of this study are important for several reasons. Firstly, we have empirically demonstrated that the perceived difficulty of the transition period on its own does not influence students' clinical performance. Secondly, we have shown that merely enhancing students' knowledge and skills levels will not ease the stress of the transition period. The satisfactory response rates from both the university hospital and affiliated hospitals strengthen the findings of this study. More importantly, the findings are based on a questionnaire, which was developed on the basis of a properly developed theoretical framework and which was found to be reliable.<sup>8,9</sup> However, as this was the first study in which this questionnaire was applied, future research on the reliability and validity of the questionnaire is desirable.

A possible weakness of this study is that the participants were all students from the same university. Although future research is needed to show whether our findings are applicable to medical schools with conventional pre-clinical curricula, the involvement of nine hospital sites in this study strengthens the generalisability of our findings. The fact that this study was based on only one institution was seen as being technically practical, as disturbing influences resulting from differing assessment standards were minimised and as it allowed as pure a measurement of the influence of pre-clinical knowledge and skills levels as possible. Given the implementation of the Bologna Process in Europe, this raises the question of whether our findings would also hold true for graduate-entry students. It is, for example, plausible that the difficulty of transition might be greater for graduate-entry

students who have undertaken preparatory medical training at another faculty. We have reason to believe, however, that this risk is not very great. In many medical faculties, at least in the Netherlands, special programmes have been developed for graduate-entry students in order to eliminate deficiencies caused by differences in pre-clinical programmes. Previous research has shown that such graduate-entry programmes are very effective: a 1-year transitional programme for students with degrees in areas related to medicine was effective in increasing their knowledge to at least the same level as that of regular students.<sup>16</sup>

Another limitation of this study concerns assessment of the students' clinical performance. In general, clinical teachers give high marks to all students. This may lead to a restriction of range in performance scores. However, all students were found competent enough to start the clinical training period. Therefore, after 3 years of pre-clinical training we would not expect to find large performance differences between students.

Future research should firstly focus on more in-depth analysis of the increased cognitive load during the pre-clinical-clinical transition period. It might also explore whether students from conventional and PBL curricula and graduate-entry students differ with respect to the degree to which they experience transition difficulties. Furthermore, it would also be interesting to analyse why students experience different amounts of cognitive load in different settings and hospitals.

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*Contributors:* EAvH was responsible for conducting the study and writing the manuscript. JC-S supervised the study and was involved in the conceptualising process. JBMK was involved in the design. JS-A made critical revisions. All authors contributed to the interpretation of the results, commented on several drafts of the manuscript and approved the final version of the paper.

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